Experimental report

03/11/2019

Proposal: 4-05-726 **Council:** 10/2018

Title: Direct measurement of the magneticphoton excitations in the Quantum Spin Ice Pr2Hf2O7

Research area: Physics

This proposal is a new proposal

Main proposer: Romain SIBILLE

Experimental team: Romain SIBILLE
Victor POREE

Local contacts: Peter FOUQUET

Samples: Pr2Hf2O7

Instrument	Requested days	Allocated days	From	To
IN11	7	7	26/06/2019	03/07/2019

Abstract:

The Quantum Spin Ice (QSI) state, where the two-in-two-out configurations formed by the Ising variables are allowed to tunnel among themselves, is realised in Pr2Hf2O7 based on our last measurements on IN5 (Nature Physics, 14, 711-715 (2018)). The quantum field theory (quantum electrodynamics) that was used to compare with our data, predicts another distinctive feature for this ground state: our energy-integrated quasi-elastic signal from IN5 should be made of dispersive excitations that play the role of emergent photons (Phys. Rev. B, 86, 075154 (2012)). We propose to measure directly these gapless low-energy excitations, whose bandwidth is predicted to be within 0.01 meV according to our estimate of the speed of the emergent photon based on our last IN5 data.

Experiment: 4-05-726

The experiment took place from the 26/06/2019 to the 02/07/2019 on IN11. After setting the instrument, the dilution fridge containing the sample was introduced on the instrument. Once base temperature was reached, rapid measurements were conducted so as to estimate the amount of measuring time required at each angular position of the detector. The last detector position was not used for the rest of the experiment due to the lack of signal. After launching the first and second scans (85mK see **figure 1** and 0.5K), issues with the dilution set point were faced. After solving the problem, scans were collected to improve statistics of the previous measurements and measure at additional temperatures. The weakness of the signal requires careful analysis and thus additional time and efforts to provide any conclusive results.

Figure 1: Echo signals from the $PrHf_2O_7$ powder sample. **a**, **b** and **c** correspond to echos taken at the first, second and third positions of the detector at 85mK.